

WHAT IS CLAIMED IS:

1. A method for fabricating a semiconductor device, the method comprising the steps of:

5 forming a gate insulating film and a gate electrode film on a semiconductor substrate;

patterning the gate electrode film to form a gate electrode;

removing a portion of the gate insulating film to form an undercut region beneath the gate electrode;

10 forming a buffer silicon film on an entire surface of the resultant substrate, the buffer silicon film covering the gate electrode and filling the undercut region; and

selectively oxidizing the buffer silicon film to form a buffer silicon oxide film.

2. The method of claim 1, wherein the portion of the gate insulating film is
15 removed using a wet etch process.

3. The method of claim 1, wherein the buffer silicon film is oxidized to function as an oxidation stop layer for preventing the gate electrode from being oxidized.

20 4. The method of claim 1, wherein the gate electrode film forming step comprises the steps of:

forming a silicon film on the gate insulating film;

forming a refractory metal film on the silicon film; and
forming a capping nitride film on the refractory metal film.

5 5. The method of claim 4, wherein the refractory metal film is formed of at
least one selected from a group consisting of tungsten, titanium, tantalum, molybdenum,
cobalt, magnesium, nickel and copper.

6. The method of claim 4, further comprising the step of forming a barrier
metal film on the silicon film prior to forming the refractory metal film.

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7. The method of claim 1, further comprising the steps of:
performing a lightly-doped implantation to form a lightly-doped impurity region
in the semiconductor substrate at both sides of the buffer silicon oxide film formed on
sidewalls of the gate electrode;

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forming a spacer nitride film on the buffer silicon oxide film;
etching-back the spacer nitride film to form a nitride spacer only on the
sidewalls of the buffer silicon oxide film formed on the sidewalls of the gate electrode;
and

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performing a heavily-doped implantation into the resultant substrate to form a
heavily-doped impurity region next to the lightly-doped impurity region, in the
semiconductor substrate outside the nitride spacer.

8. The method of claim 7, further comprising the step of etching-back the buffer silicon film so as to allow the buffer silicon film to remain only on the sidewalls of the gate electrode and in the undercut region.

5 9. A method for fabricating a semiconductor device, comprising the steps of:

forming a gate insulating film and a gate electrode on a semiconductor substrate;
etching and removing the gate insulating film exposed at both sides of the gate electrode and at an edge portion of the gate insulating film beneath the gate electrode, to
10 thereby form an undercut region beneath the gate electrode;

forming a buffer silicon film on an entire surface of the resultant substrate; and
selectively oxidizing the buffer silicon film to form a buffer silicon oxide film.

10. The method of claim 9, further comprising the steps of:
15 performing a lightly doped implantation into the buffer silicon oxide film to form a lightly-doped impurity region in the semiconductor substrate at both sides of the buffer silicon oxide film formed on sidewalls of the gate electrode;

forming a spacer nitride film on the buffer silicon oxide film;
etching-back the spacer nitride film to form a nitride spacer only on the
20 sidewalls of the buffer silicon oxide film formed on the sidewalls of the gate electrode;
and

performing a heavily-doped implantation into the resultant substrate to form a heavily-doped impurity region next to the lightly-doped impurity region, in the semiconductor substrate outside the nitride spacer.

5 11. The method of claim 9, wherein the gate electrode forming step comprises the steps of:

forming a silicon film, a tungsten film and a capping nitride film on the gate insulating film; and

patterning the capping nitride film, the tungsten film and the silicon film.

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12. The method of claim 11, further comprising the step of forming a barrier metal film between the silicon film and the tungsten film.

13. The method of claim 9, wherein the buffer silicon film is oxidized to act
15 as an oxidation stop layer, thereby preventing the gate electrode from being oxidized.

14. The method of claim 9, wherein the portion of the gate insulating film is removed using a wet etch process.

20 15. A method for fabricating a semiconductor device, comprising the steps of:

forming a gate insulating film, a silicon film, a barrier metal film, a tungsten film and a capping nitride film on a semiconductor substrate;

patterning the capping nitride film, the tungsten film, the barrier metal film and the silicon film to form a gate electrode;

wet-etching and removing the gate insulating film exposed at both sides of the gate electrode and at an edge portion of the gate insulating film beneath the gate electrode,
5 to form an undercut region beneath the gate electrode;

forming a buffer silicon film on an entire surface of the resultant substrate in which the undercut region is formed;

selectively oxidizing the buffer silicon film to form a buffer silicon oxide film;

performing a lightly-doped implantation into the buffer silicon oxide film to
10 form a lightly-doped impurity region in the semiconductor substrate at both sides of the buffer silicon oxide film formed on sidewalls of the gate electrode;

forming a spacer nitride film on the buffer silicon oxide film;

etching-back the spacer nitride film to form a nitride spacer; and

performing a heavily-doped implanting into the resultant substrate to form a
15 heavily-doped impurity region next to the lightly-doped impurity region, in the semiconductor substrate outside the nitride spacer.

16. The method of claim 15, further comprising the step of etching-back the buffer silicon film so as to allow the buffer silicon film to remain only on the sidewalls of
20 the gate electrode and in the undercut region.

17. The method of claim 15, wherein the buffer silicon film is oxidized to act as an oxidation stop layer, thereby preventing the gate electrode from being oxidized.

18. A semiconductor device, comprising:

a semiconductor substrate;

a gate electrode formed over the substrate, the gate electrode including a gate insulating film, a portion of the gate insulating film being removed to form an undercut

5 region beneath the gate electrode; and

a buffer silicon oxide film formed over sidewalls of the gate electrode and within the undercut region.

19. The semiconductor device of claim 18, further comprising:

10 lightly-doped impurity regions formed in the semiconductor substrate at sides of the buffer silicon oxide film.

20. The semiconductor device of claim 18, further comprising;

nitride spacers formed on sidewalls of the buffer silicon oxide film; and

15 heavily doped impurity regions formed next to the lightly-doped impurity regions in the semiconductor substrate at sides of the nitride spacers.